Appendix 2

Factors for control charts

Sample size	Hartley's constant	c_4 constant	For charts based on ranges			For charts based on standard deviations		
			Xbar chart limits	R chart limits		Xbar chart limits	S chart limits	
n	d_2	c_4	A_2	D_3	D_4	A_3	B_3	B_4
2	1.128	0.7979	1.880	*	3.267	2.659	*	3.267
3	1.693	0.8862	1.023	*	2.575	1.954	*	2.568
4	2.059	0.9213	0.729	*	2.282	1.628	*	2.266
5	2.326	0.9400	0.577	*	2.115	1.427	*	2.089
6	2.534	0.9515	0.483	*	2.004	1.287	0.030	1.970
7	2.704	0.9594	0.419	0.076	1.924	1.182	0.118	1.882
8	2.847	0.9650	0.373	0.136	1.864	1.099	0.185	1.815
9	2.970	0.9693	0.337	0.184	1.816	1.032	0.239	1.761
10	3.078	0.9727	0.308	0.223	1.777	0.975	0.284	1.716
11	3.173	0.9754	0.285	0.256	1.744	0.927	0.321	1.679
12	3.258	0.9776	0.266	0.283	1.717	0.886	0.354	1.646
13	3.336	0.9794	0.249	0.307	1.693	0.850	0.382	1.618
14	3.407	0.9810	0.235	0.328	1.672	0.817	0.406	1.594
15	3.472	0.9823	0.223	0.347	1.653	0.789	0.428	1.572
16	3.532	0.9835	0.212	0.363	1.637	0.763	0.448	1.552
17	3.588	0.9845	0.203	0.378	1.622	0.739	0.466	1.534
18	3.640	0.9854	0.194	0.391	1.608	0.718	0.482	1.518
19	3.689	0.9862	0.187	0.403	1.597	0.698	0.497	1.503
20	3.735	0.9869	0.180	0.415	1.585	0.680	0.510	1.490
21	3.778	0.9876	0.173	0.425	1.575	0.663	0.523	1.477
22	3.819	0.9882	0.167	0.434	1.566	0.647	0.534	1.466

			For charts based on ranges			For charts based on standard deviations		
Sample size	Hartley's constant	c_4 constant	Xbar chart limits	R chart limits		Xbar chart limits	S chart limits	
n	d_2	c_4	A_2	D_3	D_4	A_3	B_3	B_4
23	3.858	0.9887	0.162	0.443	1.557	0.633	0.545	1.455
24	3.895	0.9892	0.157	0.451	1.548	0.619	0.555	1.445
25	3.931	0.9896	0.153	0.459	1.541	0.606	0.565	1.435

An asterisk indicates that the corresponding chart limit is set to zero.

When using ranges an estimate of process standard deviation is:

$$\hat{\sigma} = \frac{\bar{R}}{d_2}.$$

When using standard deviations a recommended estimate of process standard deviation, discussed in Chapter 5, is:

$$\hat{\sigma} = \frac{s_{\text{Pooled}}}{c_4}.$$